Extended Diversion Time Operations Workshop

Module 5
Flight Operations Considerations
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Flight Operations Considerations
At the end of this module, participants will understand the flight operations requirements and dispatch planning considerations supporting EDTO operations.
EDTOM References


Chapter 3: EDTO flight operations requirements

3.1 General
3.2 Conversion of threshold and maximum diversion time into distance
3.3 Operations beyond 60 minutes
3.4 Operations beyond EDTO threshold time
3.5 Flight preparation considerations
3.6 In-flight considerations
3.7 Aeroplane performance data
3.8 EDTO flight operations manual (EFOM)
3.9 EDTO training programme
Part I — Defining the EDTO Area of Operations

Part II — Performing EDTO Flight Planning

Part III — Conducting EDTO Flights

Part IV — Documentation and Training

Part V — Practical Exercise
Area of Operation Determination

Objective:

• To establish a geographic region for conducting EDTO flight operations, or to demonstrate that an operation does not require EDTO capability. The area of operations assessment establishes applicability of the standards set forth in Annex 6, Part 1 and associated State regulations.

  - Does the operation require a diversion time in excess of 60 minutes? (If so, Section 4.7.1 applies)

  - Does the operation require a diversion time in excess of the state established threshold time? (If so, Section 4.7.2 and Specific EDTO Approval applies)

  - If EDTO, what is the maximum diversion time (MDT) required?
Annex 6, Part 1 (4.7.2.1):

- EDTO specific approval is required to operate on routes where the diversion time to an *enroute alternate aerodrome* exceeds a *threshold time* established by the State.
  - *One engine inoperative (OEI) speed* for two engine aeroplanes
  - *All engines operating (AEO) speed* for aeroplanes with more than two engines
  - *Standard day (ISA), still air conditions*

- Diversion time must be converted to distance to establish geographic applicability *(ref Attachment C, and Chapter 3 of the EDTOM).*
Area of Operation Dependencies

• The primary factors affecting the EDTO Area of Operation determination include the selection of:
  • Enroute alternate aerodromes
  • Maximum Diversion Time (MDT)
  • Assumed Diversion Speed (OEI or AEO)
  • Assumed Diversion Weight (Reference Weight)

To Establish Diversion Distance

• These same considerations apply to area of operations determination for:
  • 60-minute operations
  • Operations within the EDTO threshold time
• **Enroute Alternate Aerodrome (Annex 6, Part 1 Definitions)**

**Alternate Aerodrome**: An aerodrome to which an aircraft may proceed when it becomes either impossible or inadvisable to proceed to or to land at the aerodrome of intended landing where the necessary services and facilities are available, where aircraft performance requirements can be met and which is operational at the expected time of use.

**En-route alternate**: An alternate aerodrome at which an aircraft would be able to land in the event that a diversion becomes necessary while en route.

**Note**: Enroute alternate aerodromes may also be the takeoff and/or destination aerodromes
En-route Alternate Aerodrome Considerations

- **Availability** *(e.g. hours of operation or ability to respond to a diversion)*
- **Performance requirements** for the expected landing weight *(e.g. runway length, width)*
- **Runway strength** *(with allowance for ICAO and State overload guidance)*
- **Ground operational services** *(ATS, lighting, communications, weather reporting)*
- At least one let down navigation aid and **approach procedure**
- **Emergency services** *(Minimum RFFS Category 4)*
- **Other criteria**: Maintenance facilities, passenger accommodations…

* ICAO Doc 9157 - Aerodrome Design Manual, Part 3 - Pavements, Chapter 2
Assumed weight at diversion (Reference Weight)

• Not specifically defined in the ICAO Standards, but intended to be a representative weight for the planned EDTO operation.

• Potential approaches:
  – Weight at xx minutes (EDTO threshold time) into a typical mission
  – Heaviest expected weight at EDTO Entry Point (EEP)
  – Heaviest expected weight at Equal Time Points (ETPs) between EDTO diversion aerodromes.
Approved one engine inoperative (OEI) speed

- Typically a Mach/Indicated Airspeed (IAS) combination, which must be within the certified operating limits of the aeroplane

- Basis for both the EDTO area of operation diversion distance and engine inoperative diversion fuel requirements

- Normally a high speed approaching $M_{MO}/V_{MO}$ is selected, but this may be reduced if diversion fuel limitations or altitude capability considerations are a factor

- The diversion distance calculation assumes Maximum Continuous Thrust (MCT) on the operating engine and includes a driftdown profile from the initial all engine cruise altitude
Example Operational Flight Envelope

- Based on upset protection to maximum dive speeds ($M_D, V_D$)
- Some margin is typically included in overspeed warning systems (e.g. $V_{MO} - 5$ KIAS)
- Speeds for best fuel burn are typically well below max operating speeds (e.g. WP-911 LRC ~ 0.84 Mach)
• Driftdown Profile Example (Still Air, ISA):

Diversion Distance is a function of:
• Diversion Time
• OEI speed (Mach/IAS)
• Reference Weight
• Effect of Diversion Weight and Speed

- Higher reference weight reduces altitude profile and distance
- Higher OEI speed reduces altitude profile
- Diversion distance improvement at higher speeds may be offset by reduced altitude capability (true airspeed effect)
### Example Diversion Distance Information

<table>
<thead>
<tr>
<th>Diversion Speed (M/KIAS)</th>
<th>Weight at Diversion (1000 KG)</th>
<th>Level Off Flight Level (100 FT)</th>
<th>Diversion Time (MIN)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60</td>
<td>120</td>
<td>180</td>
</tr>
<tr>
<td>170</td>
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</tr>
<tr>
<td>250</td>
<td>190</td>
<td>412</td>
<td>806</td>
</tr>
</tbody>
</table>
Example Operational Diversion Distance Solution

Assumptions:

• EDTO Threshold Time: 60 Minutes
• EDTO Threshold Weight: 230,000 KG
• Maximum Diversion Time: 240 Minutes
• One Engine Inop (OEI) Speed: .84 Mach / 330 KIAS
### Example Diversion Distance Information

<table>
<thead>
<tr>
<th>DIVERSION SPEED (M/KIAS)</th>
<th>WEIGHT AT DIVERSION (1000 KG)</th>
<th>LEVEL OFF FLIGHT LEVEL (100 FT)</th>
<th>DIVERSION DISTANCE (NM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>.84/330</td>
<td>170</td>
<td>190</td>
<td>439</td>
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<tr>
<td></td>
<td>190</td>
<td>180</td>
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</tr>
<tr>
<td></td>
<td>210</td>
<td>170</td>
<td>434</td>
</tr>
<tr>
<td>.84/310</td>
<td>230</td>
<td>160</td>
<td><strong>430</strong></td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>150</td>
<td>427</td>
</tr>
<tr>
<td>.84/330</td>
<td>170</td>
<td>220</td>
<td>424</td>
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<td></td>
<td>190</td>
<td>220</td>
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<td></td>
<td>250</td>
<td>190</td>
<td>412</td>
</tr>
</tbody>
</table>

- Engine Inoperative
- Max Continuous Thrust
- Zero Wind
EDTO Area of Operation Example

**MRU-KUL**

**Name** | **IATA** | **ICAO** | **LDA (ft)** | **Elev (ft)** | **PCN** | **RFFS**
---|---|---|---|---|---|---
Mauritius | MRU | FIMP | 9,974 | 183 | 98 | 9
Gan Island | GAN | VRMG | 8,392 | 6 | 48 | 7
Male | MLE | VRMM | 10,171 | 6 | 64 | 9
Colombo | CMB | VCBI | 10,991 | 29 | 85 | 9
Banda Aceh | BTJ | WITT | 9,843 | 64 | 88 | 7
Medan | MES | WIMK | 9,514 | 90 | 71 | 8
Padang | PDG | WIEE | 9,022 | 18 | 83 | 9
Jakarta | CGK | WIII | 11,811 | 34 | 114 | 9
Kuala Lumpur | KUL | WMKK | 13,186 | 70 | 90 | 10

**2938 NM (GC)**
EDTO Area of Operation Example

Two engine aeroplane

EDTO Area of Operation Example

- Colombo
- Banda Aceh
- Gan Island
- Jakarta
- Medan
- Padang
- Male
- Kuala Lumpur
- Mauritius

WP-911 / RG3350-89
- Reference Weight = 230,000 KG
- OEI Diversion Speed = .84M/330 KIAS

Beyond 60 Minute Operation?
EDTO Operation?
Maximum Diversion Time Required?

60 min EDTO Threshold (430 nm)
Example EDTO Dispatch Solution

120 Minutes

WP-911 / RG3350-89
- Reference Weight = 230,000 KG
- OEI Diversion Speed = .84M/330 KIAS

120 min EDTO (840 nm)
60 min (430 nm)
Considerations for a higher Maximum Diversion Time (MDT)

- Aeroplane must be configured to a higher airworthiness standard
  - CMP, MEL Compliance

- Fewer EDTO alternates required for dispatch, but more enroute alternate aerodromes within the EDTO area of operations

- Increased flexibility for weather avoidance and other operational factors

- Improved route optimization and less potential for indirect ‘dog leg’ routing
  - Reduced route time reduces potential for problems
  - Reduced over water exposure mitigates operational risk
  - Enhanced operating efficiency and safety
Example EDTO Dispatch Solution
180 Minutes

WP-911 / RG 3350-89
- Reference Weight = 230,000 KG
- OEI Diversion Speed = .84M/330 KIAS

- Male
- Gan Island
- Colombo
- Banda Aceh
- Medan
- Kuala Lumpur
- Jakarta
- Mauritius
- Padang

60 min (430 nm)

180 min EDTO (1250 nm)
All engines operating (AEO) speed

- Typically a fixed Mach number or Indicated Airspeed (IAS), which must be within the certified operating limits of the aeroplane.
- Basis for the EDTO area of operation diversion distance, but no relationship to EDTO diversion fuel planning.
- Normally a high speed approaching MMO/VMO is selected to maximize EDTO time limited system capability.
- The diversion distance calculation is based on a fixed true airspeed (no driftdown), at an assumed all engine cruise altitude.
Example Operational Diversion Distance Solution

Assumptions:

- EDTO Threshold Time: 120 Minutes = 964 NM \(^{[2]}\)
- EDTO Threshold Weight: 220,000 KG
- Optimum Altitude: FL 380
- All Engines Operating (AEO) Speed: .84 Mach = 482 KTAS \(^{[1]}\)

\[ \begin{align*}
\text{Example} & \quad \text{TAS} = 661.4786 \times M \sqrt{\theta} \\
\text{Example} & \quad \text{Dist} = (\text{TAS} \times \text{Time}) \div 60
\end{align*} \]
### EDTO Area of Operation

Aeroplanes with more than two engines

#### Example All Engine Cruise Information*

<table>
<thead>
<tr>
<th>PRESS ALT (1000 FT)</th>
<th>KIAS STD TAT KIAS</th>
<th>260</th>
<th>250</th>
<th>240</th>
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<th>220</th>
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<td>%N1 MAX TAT FF/ENG</td>
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<td>26</td>
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</table>

* Shaded area approximates Optimum Altitude

**WP-3 / MT2021**

- All Engines Operating
- .84 Mach
EDTO Area of Operation Example

Aeroplanes with more than two engines

Example

WP-3 / MT2021
- Reference Weight = 220,000 KG
- AEO Diversion Speed = 482 KTAS

Beyond 60 Minute Operation?
EDTO Operation?

Mauritius

Colombo

Banda Aceh

Male

Gan Island

Medan

Padang

Kuala Lumpur

Jakarta

60 min (482 nm)

120 min EDTO Threshold (964 nm)

Reference Weight = 220,000 KG
AEO Diversion Speed = 482 KTAS
Q5.1 Choose the most appropriate definition of the term ‘MDT’

- Maintenance Data Terminal
- Mean Down Time
- Maximum Diversion Time
- Mission Design Team
Q5.2 Which of the following has no impact on the EDTO diversion distance calculation

- Diversion time
- OEI or AEO speed
- Assumed diversion weight
- Enroute alternate aerodromes
Part I — Defining the EDTO Area of Operations
Part II — Performing EDTO Flight Planning
Part III — Conducting EDTO Flights
Part IV — Documentation and Training
Part V — Practical Exercise
Planning for EDTO routes typically involves two phases:

- **EDTO Approval Planning**
  - The EDTO Route Authorization or initial conceptual planning phase which precedes EDTO Operational Approval

- **EDTO Dispatch Planning**
  - The day-to-day EDTO operational flight planning prior to each EDTO flight

Note: The decisions made in the initial approval planning phase will establish the basis for day-to-day EDTO dispatch planning
Performing EDTO Flight Planning

EDTO Approval Planning
(Still air planning exercise)

- Determine approved diversion speed and Maximum Diversion Time (MDT)
- Evaluate enroute alternate aerodromes
- Establish approved EDTO area of operation
- Implement EDTO flight planning system

EDTO Dispatch Planning
(Considers forecast weather conditions)

- MDT is a dispatch limitation. Check diversion fuel considering forecast wind and temperature.
- Select EDTO alternate aerodromes
- Establish dispatch EDTO area of operation
- Execute EDTO flight planning system
• **EDTO Entry Point (EEP):**

The *first point* on an EDTO flight, under standard conditions in still air, that is beyond the state established threshold time from an enroute alternate aerodrome

Determined using the OEI speed for two engine aeroplanes and the AEO speed for aeroplanes with more than two engines

• **EDTO Exit Point (EXP):**

The *last point* on an EDTO flight, under standard conditions in still air, that is beyond the state established threshold time from an enroute alternate aerodrome
Example - EDTO Entry/Exit Points

MRU to KUL

WP-911 / RG3350-89
- Reference Weight = 230,000 KG
- OEI Diversion Speed = .84M/330 KIAS

60 min (430 nm)

EEP (MRU)

180 min EDTO (1250 nm)

EEP (PDG)
Example - Multiple EDTO Sectors?

MRU to BKK

WP-911 / RG3350-89
- Reference Weight = 230,000 KG
- OEI Diversion Speed = .84M/330 KIAS

Typically the entire route segment from the first EEP to the last EXP is considered to be the EDTO Sector.
• **EDTO Equal Time Point (ETP):**
  
  A point of equal diversion time between EDTO alternate aerodromes, considering forecast wind and temperature conditions at the applicable diversion flight level.

• **Critical Point (CP):**
  
  The EDTO ETP at which the EDTO diversion fuel required exceeds or is closest to the normal planned fuel load.

  Typically the last ETP on an EDTO flight.
Example - EDTO Equal Time Points

WP-911 / RG3350-89
- Reference Weight = 230,000 KG
- OEI Diversion Speed = .84M/330 KIAS

ETP1 (MRU-MLE)
- 60 min (430 nm)

ETP2 (MLE-PDG)
- 180 min EDTO (1250 nm)

Which ETP is the Critical Point (CP)?

Note: Still air ETPs shown for illustration purposes
EDTO Equal Time Points
Effect of forecast wind and temperature

Same Conditions

+ 60kt / ISA

ETP is the geographic mid point

- 60kt / ISA-10

Different Conditions

MLE

PDG

+ 60 kt / ISA+10

Which direction will wind shift ETP?
What about the temperature difference?
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Special Case - Single EDTO Alternate
MRU to KUL

WP-911 / RG3350-89
- Reference Weight = 230,000 KG
- OEI Diversion Speed = .84M/330 KIAS

- 180 min EDTO (1250 nm)
- EXP (PDG-GAN)
- 60 min (430 nm)
- EEP (MRU-GAN)

Diversion should be protected from EEP to EXP
### EDTO Alternate Aerodrome (EDTOM Definitions)

An en-route alternate aerodrome that is designated in a dispatch or flight release for use in the event of a diversion during an EDTO flight, and which meets the applicable dispatch minima (weather and field conditions)

This definition applies to flight planning and does not in any way limit the authority of the pilot in command during flight

**Note:** EDTO alternate aerodromes may also be the takeoff and/or destination aerodromes
EDTO Dispatch Planning Weather Minimums

• Ceiling and visibility requirements for EDTO dispatch planning which are more conservative than the normal operating minimums required to conduct an approach.

• Intended to account for potential deteriorating weather conditions over a ‘period of validity’ during the EDTO flight.

• Published NOTAMs and MEL constraints may impact available approach procedures and required minimums for dispatch.

• Specific requirements may vary from State to State (e.g. relief for conditional forecast elements).

• Applicable to dispatch only, normal operating minimums apply once enroute.
### Example EDTO Dispatch Planning Minimums
(May vary from State to State)

<table>
<thead>
<tr>
<th>Approach Facility</th>
<th>Ceiling</th>
<th>Visibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision approach</td>
<td>Authorized DH/DA plus an increment of 60 m (200 ft)</td>
<td>Authorized visibility plus an increment of 800 m</td>
</tr>
<tr>
<td>Non-precision approach or circling approach</td>
<td>Authorized MDH/MDA plus an increment of 120 m (400 ft)</td>
<td>Authorized visibility plus an increment of 1500 m</td>
</tr>
</tbody>
</table>
Example Aerodrome Approach Minimums (Gan Island)

<table>
<thead>
<tr>
<th>VRMG — GAN</th>
<th>GAN ISLANDS, MALDIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation 5'</td>
<td></td>
</tr>
<tr>
<td>GND 121.6</td>
<td>TWR 119.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RWY 28</th>
<th>MDA</th>
<th>RVR</th>
<th>Circling</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td>400 ft (1 600 m)</td>
</tr>
<tr>
<td>B</td>
<td>360</td>
<td>1 200 m</td>
<td>500 ft (1 600 m)</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td>600 ft (2 400 m)</td>
</tr>
<tr>
<td>D</td>
<td>360</td>
<td>2 000 m</td>
<td>700 ft (3 600 m)</td>
</tr>
</tbody>
</table>

For illustrative purposes only — not for operational use.
Based on this example, what are the EDTO dispatch planning minimums for a Cat D straight-in approach to Rwy 28?
Q5.3 EDTO Dispatch Planning Minimums (GAN, RWY 28)

- 360 ft ceiling and 2000 m visibility
- 760 ft ceiling and 3500 m visibility
- 400 ft ceiling and 1500 m visibility
- 700 ft ceiling and 3600 m visibility
Based on this example, what are the EDTO dispatch planning minimums for a Cat D straight-in approach to GAN RWY 28?

<table>
<thead>
<tr>
<th>RWY 28</th>
<th>MDA</th>
<th>RVR</th>
<th>Circling</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>360 ft</td>
<td>1200 m</td>
<td>400 ft (1600 m)</td>
</tr>
<tr>
<td>B</td>
<td>360 ft</td>
<td>2400 m</td>
<td>500 ft (1600 m)</td>
</tr>
<tr>
<td>C</td>
<td>360 ft</td>
<td>2000 m</td>
<td>600 ft (2400 m)</td>
</tr>
<tr>
<td>D</td>
<td>360 ft</td>
<td>2000 m</td>
<td>700 ft (3600 m)</td>
</tr>
</tbody>
</table>

**Approach Facility** | **Ceiling** | **Visibility** |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision approach</td>
<td>Authorized DH/DA plus an increment of 60 m (200 ft)</td>
<td>Authorized visibility plus an increment of 800 m</td>
</tr>
<tr>
<td>Non-precision approach or circling approach</td>
<td>Authorized MDH/MDA plus an increment of 120 m (400 ft)</td>
<td>Authorized visibility plus an increment of 1500 m</td>
</tr>
</tbody>
</table>

760 ft ceiling (360 + 400) and 3500 m visibility (2000 + 1500)
Period of Validity (EDTOM Section 3.5.2.3)

- The ‘time window’ over which the forecast weather conditions should meet or exceed the EDTO dispatch planning minima at a particular EDTO Alternate Aerodrome

- Considers the earliest to latest expected arrival times at the EDTO alternate in the event of an enroute diversion
  - Some States have applied additional margins (e.g. 1 hour) to these times
EDTO Alternate Considerations

Period of Validity Example (GAN)

Diversion defining earliest ETA
Diversion defining latest ETA

Typical case with ETP before and after EDTO alternate
Period of Validity Example (GAN)

- Diversion defining earliest ETA
- Diversion defining latest ETA

Special case for single EDTO alternate
EDTO Alternate Considerations

Period of Validity Example (MRU, PDG)

- Diversion defining earliest ETA
- Diversion defining latest ETA

Typical case for first and last EDTO alternates
Typical EDTO Flight Plan Presentation

<table>
<thead>
<tr>
<th>EDTO</th>
<th>Validity Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIMP</td>
<td>FROM 1347 UTC / TO 1547 UTC</td>
</tr>
<tr>
<td>VRMG</td>
<td>FROM 1546 UTC / TO 1827 UTC</td>
</tr>
<tr>
<td>WIEE</td>
<td>FROM 1828 UTC / TO 1839 UTC</td>
</tr>
</tbody>
</table>

The last EDTO alternate typically has the shortest period of validity (additional time margin may be appropriate).

How is the flight plan validity period confirmed?

ICAO EDTO Workshop – Module 5: Flight Operations Considerations
Rescue and Fire Fighting Service (RFFS)

- The minimum RFFS level for an EDTO alternate aerodrome is Category 4 independent of the aeroplane RFFS category
  - Any modification by NOTAM should be considered
- Some States have adopted additional requirements (e.g. RFFS 7) for EDTO beyond 180 minutes
- State regulations may also include allowance for fire fighting resources outside of the aerodrome environment (with sufficient response time)
- Additional guidance on RFFS levels for all aerodromes is provided in Attachment I to Annex 6, Part I
EDTO Critical Fuel Scenario

• A check against the normal planned fuel load to ensure diversion fuel protection for EDTO (adjust fuel load if required)

• EDTO fuel protection considers three ‘scenarios’ from the most critical point (CP) on an EDTO route to a designated EDTO alternate aerodrome:
  – Engine Failure (Two Engine Aeroplanes only)
  – Decompression
  – Simultaneous Engine Failure and Decompression
Fuel Allowances:
• Icing/anti-ice
• Performance degradation
• Wind forecast errors
• Holding and approach
• APU (if required)
### EDTO Critical Fuel Scenario

**Diversion Speed Modes**

<table>
<thead>
<tr>
<th>Two engine aeroplanes</th>
<th>60 Min/EDTO Threshold Distance</th>
<th>EDTO Max Diversion Distance</th>
<th>Critical Fuel – All engine depressurization</th>
<th>Critical Fuel – Engine inop depressurization</th>
<th>Critical fuel – Engine failure only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any selected OEI Speed</td>
<td>Approved OEI speed</td>
<td>Any selected AEO speed</td>
<td>Approved OEI speed</td>
<td>Approved OEI speed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Aeroplanes with more than two engines</th>
<th>60 Min/EDTO Threshold Distance</th>
<th>EDTO Max Diversion Distance</th>
<th>Critical Fuel – All engine depressurization</th>
<th>Critical Fuel – Engine inop depressurization</th>
<th>Critical fuel – Engine failure only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Any selected AEO speed</td>
<td>Approved AEO speed</td>
<td>Any selected AEO speed</td>
<td>Any selected OEI speed</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

May also apply to EDTO threshold distance, if EDTO is required

- For two engine aeroplanes, the assumed speed for the engine failure critical fuel scenarios is the approved OEI speed used to define the EDTO maximum diversion distance.

---

28/10/2019  
ICAO EDTO Workshop – Module 5: Flight Operations Considerations
EDTO Critical Fuel Check

Example: No Additional EDTO Fuel Required

- **Hold**
  - Diversion to Destination Alternate
  - Contingency

- **Trip to destination**

- **Standard fuel calculation**

- **Trip to the most critical point**

- **Critical Fuel to EDTO Alternate**

- **Taxi**

- **EDTO fuel calculation**

No additional EDTO fuel required
EDTO Critical Fuel Check

Example: Additional EDTO Fuel Required

Additional EDTO fuel required

Additional Fuel

- Hold
- Diversion to Destination Alternate
- Contingency

Trip to destination

Taxi

Standard fuel calculation

Critical Fuel to EDTO Alternate

Trip to the most critical point

Taxi

EDTO fuel calculation
Example - No Additional EDTO Fuel Required*

Critical Fuel Scenario
Operational Application

Example - No Additional EDTO Fuel Required*

*Normal fuel on board (FOB) exceeds critical fuel requirement (CFR) at each ETP
**Example - Additional EDTO Fuel Required**

<table>
<thead>
<tr>
<th>CRITICAL POINT AT : ETP2 FUEL EXCESS OF 00000</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIST</td>
</tr>
<tr>
<td>ETP1</td>
</tr>
<tr>
<td>S14456</td>
</tr>
<tr>
<td>ETP2</td>
</tr>
<tr>
<td>S06438</td>
</tr>
</tbody>
</table>

*Normal fuel on board (FOB) adjusted for critical fuel requirement (CFR) at ETP2*
**EDTO Critical Fuel Scenario**

**Operational Application**

### Example - Additional EDTO Fuel Required*

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Time</th>
<th>OWE</th>
<th>Pyld</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEST WMKK</td>
<td>34963</td>
<td>6+58</td>
<td>AZFW 111864</td>
</tr>
<tr>
<td>RESV</td>
<td>1049</td>
<td>. . .</td>
<td>ATOW 154500</td>
</tr>
<tr>
<td>DEST-MNVR</td>
<td>0</td>
<td>. . .</td>
<td>ALDW 119537</td>
</tr>
<tr>
<td>ALTERNATE</td>
<td>2357</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOLD-ALT</td>
<td>2203</td>
<td>0+30</td>
<td></td>
</tr>
<tr>
<td>EDTO ADD</td>
<td>2064</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REQD</td>
<td>42636</td>
<td>7+28</td>
<td></td>
</tr>
<tr>
<td>EXTRA</td>
<td>00000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAXI</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>42736</td>
<td>7+28</td>
<td></td>
</tr>
</tbody>
</table>

---

*Additional EDTO Fuel Uplift*
• Consideration of Time Limitations:  
  Annex 6 Part 1, Attachment C (3.2.5.2 and 3.3.5.2)  
  For all operations beyond the EDTO threshold as determined by the State of  
  the Operator, the operator should consider at the time of dispatch… the most  
  limiting EDTO significant system time, if any, indicated in the aeroplane flight  
  manual (directly or by reference) and relevant to that particular operation  
  
  • **All aeroplanes**: The time capability of the cargo fire suppression system  
    minus a state established operational margin (e.g. 15 minutes)  
  
  • **Two engine aeroplanes**: An additional system time limitation (other  
    than cargo fire suppression) may be identified
EDTO Time Limited Systems (TLS)

EDTO Up to 180 Minutes *(Including 15% Operational Extension)*

- Time limited system planning based on *still air, standard day conditions*
- Does not vary from flight to flight unless aeroplane TLS configuration is impacted by MEL constraints

EDTO beyond 180 Minutes

- Time limited system planning based on *forecast wind and temperature* (planning varies from flight to flight)
- All engines operating (AEO) speed for cargo fire suppression
- One engine inoperative (OEI) speed for any two engine aeroplane time limited systems other than cargo fire suppression
Example AFM Statement - 180 Minute EDTO:

Aeroplane Flight Manual
180 Minute EDTO - Time Limited System Capability

The time capability of the most limiting EDTO significant system including cargo fire suppression is **195 minutes**

**Operational Application:**

- Still Air diversion time can not exceed EDTO TLS time minus 15 minutes
- 195 minute system time supports 180 minute EDTO (195 min - 15 min)
Consideration of Time Limited Systems based on ISA, Still Air Conditions

EDTO Dispatch Maximum Diversion Time (Still Air): 180 minutes

Cargo fire suppression system time ► check time is at least 180 min + 15 min

Other EDTO system time capability (if any) ► check time is at least 180 min + 15 min

Twins only

Check that planned still air diversion time does not exceed Time Limited System capability minus 15 minutes.
Example AFM Statement - EDT0 beyond 180 Minutes:

Aeroplane Flight Manual
EDTO Beyond 180 Minutes - Time Limited System Capability

The time capability of the cargo fire suppression system is 225 minutes
The time capability of all other EDT0 significant systems is at least 290 minutes

Operational Application:
- AEO diversion time with forecast winds and temps can not exceed cargo fire suppression time minus 15 minutes
- OEI diversion time with forecast winds and temps can not exceed other EDT0 TLS system time minus 15 minutes
Time to distance relationship depends on diversion conditions:

<table>
<thead>
<tr>
<th>Time Consideration / Diversion Flight Condition</th>
<th>Distance (NM)</th>
<th>Air</th>
<th>Ground *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>240 Minute</strong> EDTO Maximum Diversion Time <em>(ISA, still air)</em>:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• OEI Driftdown at Reference Weight and Approved OEI speed</td>
<td>1660</td>
<td>1660</td>
<td></td>
</tr>
<tr>
<td>• From Slide 15, WP-911 Diversion Distance assumed conditions:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>225 Minute</strong> Cargo Fire Suppression Time <em>(forecast winds &amp; temps)</em>:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• AEO Cruise at ETP Weight, Typical TAS = 482 knots (.84 Mach)</td>
<td>1687</td>
<td>1687</td>
<td></td>
</tr>
<tr>
<td>• 482 nm/hr * (225 min - 15 min) ÷ 60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>290 Minute</strong> Other EDTO System Time <em>(forecast winds &amp; temps)</em>:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• OEI Driftdown at ETP Weight and Approved OEI speed,</td>
<td>1899</td>
<td>1899</td>
<td></td>
</tr>
<tr>
<td>• From Slide 15 assumed conditions at 275 (290 - 15) minutes:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* TLS diversion distance will vary with forecast winds and temperatures
EDTO Time Limited Systems (TLS)
240 Minute EDTO Example

Consideration of Time Limited Systems based on forecast winds and temperatures

EDTO Dispatch Maximum Diversion Time (Still Air): 240 minutes

- Cargo fire suppression ► check planned AEO diversion time ≤ 210 minutes
- Other most limiting EDTO system (if any) ► check planned OEI diversion time ≤ 275 minutes

Time (min)

- Twins only

Air Distance (NM)

- AEO wind shift
- OEI wind shift

210 240 275
1660 1689 1899
Annex 6, Part 1 Definitions:

• **Master Minimum Equipment List (MMEL):**

  A list established for a particular aircraft type by the organization responsible for the type design with the approval of the State of Design containing items, one or more of which is permitted to be unserviceable at the commencement of a flight. The MMEL may be associated with special operating conditions, limitations or procedures.

• **Minimum Equipment List (MEL):**

  A list which provides for the operation of aircraft, subject to specified conditions, with particular equipment inoperative, prepared by an operator in conformity with, or more restrictive than, the MMEL established for the aircraft type.

  Chapter 6, 6.1.3 establishes requirement for a MEL. Additional guidance is provided in Attachment E.
EDTO MMEL/MEL restrictions may be related to:

- **The allowable Maximum Diversion Time**
  Some States have established specific requirements for EDTO up to 180 minutes and EDTO beyond 180 minutes (e.g. FAA MMEL Policy Letter 40)

- **The capability of the Time Limited Systems**
  Example: A reduction in the capacity of the cargo fire suppression system

- **Weather minimums or approach capability**
  These items are typically not stated as EDTO restrictions, but may impact the assessment of EDTO alternate aerodromes
  Example: “May be inoperative provided approach minimums do not require its use”
Example of MEL Item based on EDTO restriction:

<table>
<thead>
<tr>
<th>Repair Interval</th>
<th>No. Installed</th>
<th>No. Required</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1</td>
<td>0</td>
<td>(O) (M)</td>
</tr>
</tbody>
</table>

Except for EDTO operations, may be inoperative

What is the allowed maximum diversion time in this example?
Example of MEL Item based on diversion time restriction:

<table>
<thead>
<tr>
<th>WonderPlanes®</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP911SP+ Dispatch Deviations Guide (DDG)</td>
</tr>
</tbody>
</table>

### ATA 24, ITEM 24-02: APU Generator System

<table>
<thead>
<tr>
<th>Repair Interval</th>
<th>No. Installed</th>
<th>No. Required</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1</td>
<td>0</td>
<td>(O) (M)</td>
</tr>
</tbody>
</table>

**May be inoperative provided:**

- IDGs and Backup Generator operate normally
- Operations beyond 180 minute diversion time are not conducted.
## Additional requirements for EDTO beyond 180 minutes:

### FAR Part 121, Appendix P
- Fuel Quantity Indicating System (FQIS) *
- APU, both electrical and pneumatic
- Auto throttle system
- Second communication system (SATCOM Voice) *
- Engine-out auto-land (*if used for planning*)

### EASA AMC 20-6
- Fuel Quantity Indicating System (FQIS)
- APU, both electrical and pneumatic
- Automatic engine or propeller control system
- Communication system(s) relied on by the flight crew to comply with communication requirements
• Check Aeroplane Configuration / EDTO Status

• Nominate EDTO Alternate Aerodromes

• Establish Area of Operation

• Consider EDTO Fuel Requirements

• Prepare Flight Folder

---

**EDTO Flight Planning Summary**

<table>
<thead>
<tr>
<th>AIRCRAFT: WP-911</th>
<th>DEP: MRU/FIMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGINES: SOFT THRUST 1500</td>
<td>DEST: KUL/WMKK</td>
</tr>
</tbody>
</table>

**EDTO STATUS**

- EDTO APPROVED: AEC: Y
- EDTO APPROVED: CREW: Y
- EDTO APPROVED: ROUTE: Y
- MAXIMUM DIVERSION TIME: 180 Min
- TIME LIMITED SYSTEMS: 195 Min
- MEL /CDL: None

**EDTO ALTERNATE AERODROMES**

- WEATHER MINIMUMS: ✔
- NOTAMS: ✔

**COMPUTER FLIGHT PLAN (CFP)**

- AREA OF OPERATION: ✔
- EEP, ETP, EXP: ✔
- PERIOD OF VALIDITY: ✔
- CRITICAL FUEL CHECK: ✔

**WEATHER FOLDER**

- TAF, METARS, SIGMETS: ✔
- WINDS AND TEMPS ALOFT: ✔
- ICING FORECASTS: ✔
Q5.4 Chose the most appropriate definition of the term ‘ETP’

- Engineering Test Plan
- External Tracking Processor
- Employment Training Panel
- Equal Time Point
Q5.5 Which of the following **does not** apply to the assessment of an EDTO alternate aerodrome

- Weather minima
- Landing performance requirements
- Rescue and fire-fighting service (RFFS)
- Business lounge in passenger terminal
Q5.6 Which of the following **is not** considered in the EDTO critical fuel scenario

- Engine failure
- Decompression
- Combined engine failure and decompression
- Cargo fire
Module 5 - Outline

Part I —
Part II —
Part III —
Part IV —
Part V —

Defining the EDTO Area of Operations
Performing EDTO Flight Planning
Conducting EDTO Flights
Documentation and Training
Practical Exercise
Fundamental Concepts:

“In-flight considerations for EDTO are separate but complimentary to the flight preparation considerations discussed in Section 3.5. The pilot in command is not bound by the EDTO planning assumptions and may exercise discretionary authority to deviate from these assumptions in the event of an in-flight emergency.”

The additional in-flight considerations for EDTO primarily consist of enhanced awareness of aeroplane system and fuel status, and the monitoring of EDTO alternate aerodrome conditions… Aeroplane operating procedures are typically equally applicable to both EDTO and non-EDTO operations…
EDTO In-flight Considerations

**EDTO Flight Planning**

- EDTO Alternate dispatch planning minimums
- Determine EDTO waypoints (EEP, ETPs, EXP)
- Critical fuel requirement
- MEL is applicable
- Approved OEI or AEO speed

**EDTO Enroute Operations**

- Enroute Alternate operating minimums
- Monitor flight progress within EDTO Sector
- Operator minimum fuel policy
- QRH is applicable
- Diversion speeds may differ at PIC discretion
Standard long range navigation and communication procedures and equipment requirements apply with increased emphasis on:

- Airplane position relative to EDTO Sector (EEP, ETPs, EXP)
- Fuel progress monitoring
- En-route alternate and aeroplane system status
EDTO Alternate Weather Minima Summary:

- **Prior to Departure**: EDTO dispatch planning minimums applicable
- **Enroute before EEP**: Aerodrome operating minimums applicable
  - If an EDTO alternate falls below minimums: amend flight plan to select another EDTO alternate, continue non-EDTO, divert or turn back
- **After passing EEP**: No specific weather minima requirement

Other Operational Considerations:

- Good practice to monitor EDTO alternate status throughout flight, and update next EDTO alternate weather when passing ETP
- In case of an enroute diversion, the flight crew is not obligated to select a designated EDTO alternate and may choose another suitable aerodrome if determined to be a safer course of action
Some EDTO Maintenance Program elements have a Flight Operations interface and may require action by the flight crew:

- APU in-flight start program
- EDTO maintenance verification flights
- EDTO flight release after a non-technical diversion

These interfaces should be addressed in the operators EDTO Flight Operations documentation and training programs.

*Note:* EDTO Maintenance Program considerations for two engine aeroplanes will be discussed further in Module 6.
Diversion Decision Considerations

- QRH non-normal checklists calling for ‘Land ASAP’ or ‘Land at nearest suitable aerodrome’
  - Multiple system failures, engine failure, decompression, smoke or fire…
  - OEM non-normal procedures typically do not distinguish EDTO and are validated for both EDTO and non-EDTO operations

- Required alternates unavailable or unsuitable for use (prior to EDTO entry)

- Excessive fuel consumption, exceeding available fuel reserves

- Any other situation that the flight crew determines to have an adverse effect on safety of flight
  - Most EDTO diversions are due to non-technical causes (weather, passenger medical…)

- Comply with route requirements as for non-EDTO, coordinate/communicate with flight dispatch as required
Diversion speed and thrust selection are at the discretion of the flight crew based on prevailing operational conditions.

‘Obstacle Clearance’ Strategy
- Best altitude profile for terrain clearance
- Optimum driftdown (L/D max) speed

‘Fuel’ Strategy
- Optimizes diversion fuel required
- Descent to LRC cruise ceiling and LRC cruise

‘Fixed Speed’ (EDTO) Strategy
- Minimum diversion time (at the expense of fuel and altitude)
- Driftdown and cruise at EDTO OEI Speed
Flight crews should have access to relevant aeroplane performance data:
Q5.7 Which of the following is the most appropriate guidance for an EDTO enroute system failure

- Minimum Equipment List (MEL)
- EDTO Significant Systems List (SSL)
- Quick Reference Handbook (QRH)
- Aeroplane Flight Manual (AFM)
Module 5 - Outline

Part I — Defining the EDTO Area of Operations
Part II — Performing EDTO Flight Planning
Part III — Conducting EDTO Flights
Part IV — Documentation and Training
Part V — Practical Exercise

• Part A: General
• Part B: Aircraft Operating Information
• Part C: Areas, Routes and Aerodromes
• Part D: Training

EDTO provisions may be included in this basic structure or published in a separate stand alone EDTO flight operations manual (EFOM)
Purpose:

• To provide involved personnel and EDTO authorized persons with a descriptive means aimed at ensuring safe and efficient EDTO operations…

• Accordingly all EDTO requirements including supportive programme policies, procedures, duties, responsibilities and limitations should be identified…

Approval and revision control:

• The EFOM or EDTO sections of the basic FOM should be reviewed and approved by the responsible Flight Operations Inspector (FOI) as part of the operational approval application process.

• Major revisions to the EDTO program documentation should also be reviewed and approved prior to operator implementation.
EDTO Flight Operations Manual Content Elements:

- EDTO definitions and concepts. Information on applicable EDTO rules, operator’s EDTO program, flight preparation etc…

- AEC specific information (e.g. Max diversion times and distances, OEI or AEO speeds, EDTO procedures, performance data)

- Authorized operational areas, route specific information, enroute alternate aerodromes, approved weather minimums

- EDTO training and qualification policies and procedures, EDTO training curriculi
Considerations:

- Flight Operations personnel should complete approved training on EDTO prior to an operator receiving EDTO operational approval
  - Flight crews, flight dispatchers, other operations personnel…

- EDTO training programmes should address the specific regulations, authorizations, policies, procedures and documentation related to the particular EDTO program.
  - Flight crew training programs should include the content and duration of academic training, simulated flight demonstrations, line checks and currency requirements
  - Dispatcher training programs should also address academic training considerations as well as practical training on the specific tools and methods used for EDTO flight preparation

- Operators may employ the use of different training media and methods (e.g. CBT, standup instruction, simulation) in their EDTO training programmes
Typical Academic Training Elements:

- Familiarity with ICAO EDTO standards and relevant State regulations
- EDTO Operational Program Approvals
  - EDTO Fleet
  - Operational Area
  - EDTO Threshold, Maximum diversion times and speeds
- EDTO Flight Planning Considerations
  - EDTO area of operations
  - Alternate aerodromes for EDTO
  - EDTO fuel reserves
- EDTO Flight Planning Considerations (cont’d)
  - Time limited system considerations
  - EDTO technical status and MEL considerations
  - EDTO Flight Release and Computer Flight Plan
- EDTO Enroute Considerations
  - Standard Operating Procedures
  - Inflight Monitoring
  - Diversion Considerations
  - Non-normal and Contingency Procedures
- Aeroplane Performance Data
- EDTO Flight Operations Manual
Typical Practical Training Elements (Flight Crews):

- Preflight briefing
- EDTO flight release
- Cockpit preparation
- En-route (normal)
  - Entering EDTO Sector
  - En-route monitoring procedures
  - FMS procedures (as applicable)
  - Navigation and communication
- En-route (non-normal)
  - Contingency procedures
  - Select non-normal procedures and checklists
  - Diversion decision making
  - FMS procedures (as applicable)
  - En-route diversion
- Post-flight procedures
Recurrent Training:

- Typically conducted annually, but may vary among operators
  - Frequency, duration and specific currency requirements should be defined in each operator’s EDTO training program

- Condensed or shortened refresher academic training is normally adequate for personnel who have maintained an active role in the EDTO program
  - Repeat initial training may be appropriate for personnel who are no longer considered current

- Practical recurrent training (e.g. EDTO LOFT) should consider student exposure to different operational situations instead of repeating the same scenarios
  - Relevant experience from actual in-service events may be considered
EDTO Flight Operations Summary

Approval Planning

- Determine approved diversion speed and Maximum Diversion Time (MDT)
- Evaluate potential enroute alternates
- Establish approved EDTO area of operation
- Implement EDTO flight planning system

Dispatch Planning

- Determine EDTO waypoints (EEP, ETPs, EXP)
- EDTO alternate dispatch planning minimums
- Critical fuel requirement
- MEL is applicable
- Approved OEI or AEO speed

Enroute Operations

- Monitor flight progress within EDTO Sector
- Enroute alternate operating minimums
- Operator minimum fuel policy
- QRH is applicable
- Diversion speeds may differ at PIC discretion
Module 5 - Outline

Part I — Defining the EDTO Area of Operations

Part II — Performing EDTO Flight Planning

Part III — Conducting EDTO Flights

Part IV — Documentation and Training

Part V — Practical Exercise
EDTO Workshop

End of Module 5 - Flight Operations Considerations